



US005983225A

United States Patent [19][11] **Patent Number:** 5,983,225

Anfindsen

[45] **Date of Patent:** Nov. 9, 1999

[54] **PARAMETERIZED LOCK MANAGEMENT SYSTEM AND METHOD FOR CONDITIONAL CONFLICT SERIALIZABILITY OF TRANSACTIONS**

[75] **Inventor:** Ole Jørgen Anfindsen, Enebakk, Norway

[73] **Assignee:** Telenor AS, Enebakk, Norway

[21] **Appl. No.:** 09/013,678

[22] **Filed:** Jan. 26, 1998

[51] **Int. Cl.⁶** G06F 12/00

[52] **U.S. CL.** 707/8; 707/201; 395/726;

711/150; 711/168; 711/210

[58] **Field of Search** 707/8, 201; 395/726;

711/150, 151, 210, 163, 168, 152

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,574,350	3/1986	Starr	395/726
5,319,780	6/1994	Catino et al.	707/8
5,408,629	4/1995	Tsuchiya et al.	711/151
5,504,899	4/1996	Raz	707/10
5,551,046	8/1996	Mohan et al.	707/8
5,623,659	4/1997	Shi et al.	707/8
5,721,943	2/1998	Johnson	706/59
5,742,813	4/1998	Kavanagh et al.	707/8
5,892,954	4/1999	Tomas et al.	711/106

OTHER PUBLICATIONS

Strivastava et al., "Conditional transactions: a model of computation for active databases", Proceedings of the Fifteenth Annual International Computer Software and Application Conference, IEEE Comput. Soc. Press, Abstract only, 1991.

Anfindsen, "Conditional Conflict serializability and application-oriented correctness criterion", Journal of Database Management, vol. 9, No. 4, Abstract Only, 1998.

Anfindsen, "Parameterized access modes in apotram", Teletronikk, vol. 91, No. 4, Abstract Only, 1995.

Anfindsen et al., "Isolation levels in relational database management systems", Teletronikk, vol. 90, No. 4, Abstract only, 1994.

Raschid, et al., "A simulation-based study on the concurrent execution of rules in a database environment", Journal of Parallel and Distributed Computing, vol. 20, No. 1, Abstract Only, Jan. 1994.

(List continued on next page.)

Primary Examiner—Jean R. Homere

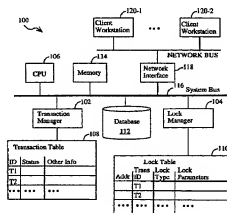
Attorney, Agent, or Firm—Pennie & Edmonds LLP

[57]

ABSTRACT

A database management system (DBMS) is modified to provide improved concurrent usage of database objects, particularly when the system is executing long lived transactions. A subset of the transactions access database objects using parameterized read and parameterized write access modes. Each transaction using a parameterized write mode of access for a database object specifies a write access mode, and a write access mode parameter, where the parameter indicates a data reliability classification. Each transaction using a parameterized read mode of access for a database object specifies a read access mode, and a read access mode parameter, where the parameter indicates one or more reliability classifications that are acceptable to the transaction. Whenever a transaction requests access to a specified database object, the DBMS generates a corresponding lock request for the object. If the lock request is a parameterized lock request, a corresponding parameterized lock request is generated. A lock manager processes each lock request by checking to see if any outstanding, previously granted lock is unconditionally conflicting or conditionally conflicting with the requested lock. Two lock requests are unconditionally conflicting if their resource range overlaps and the access modes of the two requests are incompatible. Two requests are conditionally conflicting if analysis of their read/write parameters is necessary to determine whether a conflict exists. A conditional conflict is resolved by determining whether the write parameters for the write lock in question are a subset of the read parameters for the read lock in question.

9 Claims, 4 Drawing Sheets



OTHER PUBLICATIONS

- Daynés, Laurent, et al.; "Locking in OODBMS Client Supporting Nested Transactions", *ICDE* (Mar. 1995), pp. 1-8.
- Kirsche, Thomas, et al.; "Cooperative Problem Solving using Database Conversations", *IEEE* (1994), pp. 134-143.
- García-Molina, Hector; "Using Semantic Knowledge for Transaction Processing in a Distributed Database", *ACM Transactions on Database Systems*, vol. 8, No. 2 (Jun. 1983), pp. 186-213.
- Lynch, Nancy A.; "Multilevel Atomicity—A New Correctness Criterion for Database Concurrency Control", *ACM Transactions on Database Systems*, vol. 8, No. 4 (Dec. 1983), pp. 484-502.
- Farrag, Abdel, A., et al.; "Using Semantic Knowledge of Transactions to Increase Concurrency", *ACM Transactions on Database Systems*, vol. 14, No. 4 (Dec. 1989), pp. 503-525.
- Korth, Henry F., et al.; "Formal Aspects of Concurrency Control in Long-Duration Transaction Systems Using the NT/PV Model", *ACM Transactions on Database Systems*, vol. 19, No. 3 (Sep. 1994), pp. 492-535.
- Agrawal, Divyakant, et al.; "Consistency and Orderability: Semantics-Based Correctness Criteria for Databases", *ACM Transactions on Database Systems*, vol. 18, No. 3 (Sep. 1993), pp. 460-486.

00736560 720150